Estimates of Peak Underground Working Gas Storage Capacity in the United States, 2009 Update

The aggregate peak capacity for U.S. underground natural gas storage is estimated to be 3,889 billion cubic feet (Bcf). This estimate, based on demonstrated noncoincident peak working gas storage volumes for individual active gas storage fields¹ reported to EIA over the 60-month period ending in April 2009, represents a 2.6 percent increase over last year's estimate. Working gas design capacity, an alternative, less conservative indicator of gas storage capacity, also rose over the past year. Questions or comments on the contents of this article should be directed to Angelina LaRose at angelina.larose@eia.doe.gov or (202) 586-6135.

Underground natural gas storage is a key component of the natural gas market. Natural gas in storage maintains reliability of gas supplies during periods of high demand (including both winter and summer peak days); it supports load balancing for pipelines; and it provides opportunities for owners of natural gas in storage to synchronize their buying and selling activities more effectively with market needs while minimizing their business costs.

The quantity of gas that storage operators hold is one indicator of whether there will be enough supply to meet future demand.² Although current supplies (production and net imports) are relatively constant throughout the year, natural gas demand is highly seasonal. Between April and October, natural gas is injected into storage fields for use in winter periods of high demand. During years like 2009, when storage builds have been historically large, the total amount of gas that operators can store becomes particularly important. As storage fields near their maximum capacity, constraints on storage may cause downward pressure on prices paid for current supplies of gas until the winter demand rebalances supply and demand.

This paper reports two measures of aggregate capacity, one based on demonstrated peak working gas storage, the other on working gas design capacity. Demonstrated peak working gas storage volumes provide a conservative measure of capacity that may understate the amount that could actually be stored. In contrast, working gas design capacity, a measure based on the physical characteristics of the reservoir, installed equipment, and operating procedures particular to the site that is often certified by Federal or State regulators, may overstate the amount of storage capacity that is actually available given operational, logistical, and other practical constraints.

Both demonstrated peak working gas storage capacity and working gas design capacity increased from 2008 to 2009.³

¹ Salt caverns are included in the term "field".

² A more detailed discussion of the uses of underground storage, terminology, and fields and operations is available at the Energy Information Administration report, *The Basics of Underground Storage*, http://www.eia.doe.gov/pub/oil_gas/natural_gas/analysis_publications/storagebasics/storagebasics.html.

³ Working gas is the volume of natural gas in the reservoir that is in addition to the base gas, which is the volume of natural gas intended as permanent inventory in a storage reservoir to maintain adequate pressure

- Demonstrated peak working gas storage capacity as of April 2009 was 3,889 Bcf, an increase of 100 Bcf from April 2008.
- Working gas design capacity as of April 2009 was 4,313 Bcf, an increase of 177 Bcf from April 2008.

The increase in natural gas storage capacity estimates can be attributed to the opening of new facilities, capacity expansion at existing facilities, and, for demonstrated peak capacity, greater use of existing storage facilities during the past year.

EIA's methodology and regional estimates are discussed below.⁴

Methodology

As in last year's report, estimates of demonstrated peak storage capacity are based on aggregation of the noncoincident peak levels of gas in storage at individual storage fields as reported monthly over a 5-year period to EIA on Form EIA-191M, "Monthly Underground Storage Report." This data-driven estimate reflects actual operator experience and serves as a conservative proxy for the possible limits of industry capacity. For example, this data reflects storage levels as of the last day of the report month, and a facility may have reached a higher inventory on a different day of the report month, which would not be recorded on Form EIA-191M. However, the noncoincident peak volumes exceed the largest reported monthly working gas volumes for each of the three regions for which storage data are published because not all fields held their highest volumes at the same time.

Aggregate working gas design capacity provides an alternative measure of the amount of natural gas that can be stored. However, logistical, operational, and practical considerations may preclude attainment of maximum design capacities of storage fields, so that a summation of design capacities is likely to exceed actual available maximum storage capacity.

and deliverability rates through the withdrawal season. *Working gas design capacity* is calculated as the difference between total storage design capacity and base gas.

⁴ The regions in this report are those used for the Energy Information Administration's *Weekly Natural Gas Storage Report*; see http://www.eia.doe.gov/oil_gas/natural_gas/ngs/notes.html.

⁵ Noncoincident means that the months of measurement for the peak storage volumes by field may differ; i.e., the months do not necessarily coincide. As such, the noncoincident peak for any region is at least as big as any monthly volume in the historical record.

⁶ Data from Form EIA-191M, "Monthly Underground Storage Report" is collected from storage operators on a field level basis. Operators can report field level data either on a per reservoir basis or on an aggregated reservoir basis. It is possible that if all operators reported on a per reservoir basis that the peak working gas storage capacity would be larger.

Regional and National Estimates of Gas Storage Capacity

Table 1 presents national and regional estimates of demonstrated peak working gas capacity and working gas design capacity. Total U.S. demonstrated peak working gas capacity as of April 2009 is estimated to be 3,889 Bcf, 100 Bcf above the April 2008 level, and equivalent to 90.2 percent of aggregate working gas design capacity. In the West Region, peak storage capacity is only 73.3 percent of working gas design capacity, reflecting several still-active fields that have experienced a shift in their primary role from seasonal storage to other functions, such as pipeline load balancing, and fields that are being drawn down to be taken out of service.

In all three regions, demonstrated peak working gas capacity as a percentage of working gas design capacity decreased from 2008 to 2009. This is because working gas design capacity increased faster than the peak working gas capacity in each region as a result of new facilities coming online and facility expansions. The inclusion of new capacity affects the ratio of estimated peak working gas capacity to working gas design capacity, as the incremental build of working gas in storage is on average lower than the increase that is ultimately expected to occur.

Despite the increase in both measures of gas storage capacity, the record-high level of actual working gas in storage in the lower-48 States at the end of any month remains at 3,565 Bcf, reached at the end of October 2007. However, storage operators appear on pace to set a new all-time level for working gas in storage this fall. For example, according to EIA's *Short-Term Energy Outlook* (August 2009), the end-of-October volume is expected to be 3,801 Bcf, which would be 97.7 percent of demonstrated peak working gas capacity as of April 2009.

⁷ The April 2008 estimate is from the Energy Information Administration report, *Estimates of Peak Underground Working Gas Storage Capacity in the United States* (October 7, 2008), available at http://www.eia.doe.gov/pub/oil_gas/natural_gas/feature_articles/2008/ngpeakstorage/ngpeakstorage.pdf.

⁸ New facilities accounted for the addition of 12 Bcf in the East Region, 41.8 Bcf in the Producing Region, and 19 Bcf in the West Region.

Table 1. Estimates of Natural Gas Storage Capacity and Historical Maximum Storage Volumes April 2008 and April 2009 (Billion cubic feet, unless otherwise noted)

	Estimated Peak Working Gas Capacity		Working gas design capacity		Peak Working Gas as Percent of Working gas design capacity		National and Regional Maximum End-of-Month Gas Storage Volumes	
Region	(as of) Apr- 2008	(as of) Apr- 2009	(as of) Apr- 2008	(as of) Apr- 2009	(as of) Apr- 2008	(as of) Apr- 2009	(as of) Apr-2008	(as of) Apr-2009
East	2,153	2,178	2,225	2,268	96.8%	96.0%	2,032	2,032
Producing	1,146	1,202	1,251	1,351	91.6%	89.0%	1,068	1,068
West	490	509	660	694	74.2%	73.3%	470	470
Lower 48	3,789	3,889	4,136	4,313	91.6%	90.2%	3,565	3,565

Note: The historical maximum volume for the lower-48 States does not equal the sum of the regional volumes because the regional data represent values in different months.

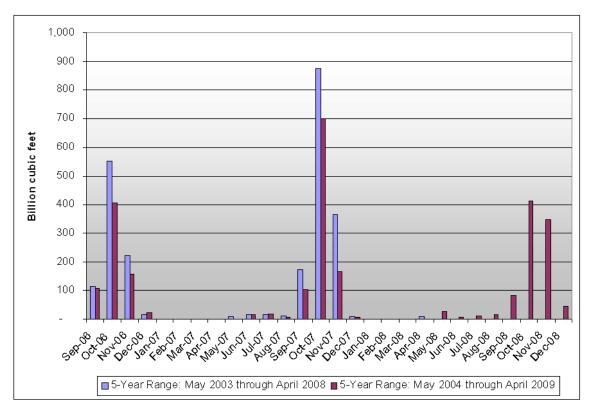
Source: Energy Information Administration (EIA), Natural Gas Division. Working gas design capacity: derived from data in the *Natural Gas Monthly* (DOE/EIA-0130), July 2008 and June 2009, Table 11. Peak gas capacity: derived from data reported on the EIA-191M, "Monthly Underground Gas Storage Report."

Although new records can be set every year, more than 61 percent of the individual storage fields that contribute to the peak gas capacity showed no change in the month of their maximum value of working gas in storage when comparing the May 2004 through April 2009 5-year range used in this analysis to the May 2003 through April 2008 used in the previous peak working gas capacity analysis. Approximately, 17 percent of the individual storage fields showed a decline in their maximum value of working gas in storage, as they reached a maximum value between May 2003 and April 2004, months which were not included in the current 5-year range. Excluding fields with known capacity reductions and shifts in operational conditions, adding back the peak gas in storage volumes reached between May 2003 through April 2004 would increase the peak working gas capacity by approximately 20 Bcf. This would increase the peak working gas as percent of working gas design capacity by 1 percent.

Approximately 20 percent of the fields reached a new peak working gas in storage since EIA's 2008 report on working gas capacity. Peak working gas in storage generally increased less than 5 percent above the previous peak at these fields. A significant number of storage fields attained their highest reported levels in October 2007 (Figure 1). These field-level maxima coincided with the historical maximum volume of 3,565 Bcf for the lower 48 States during the same month, as reported in the *Natural Gas Monthly*. However, some of the peak levels that were established at individual fields in October 2007 were exceeded the following year. Of the fields that had a maximum level of gas in storage in October and November 2007 that reached a new maximum level of storage in the current 5-year range, 20 of them reached their new peak gas in storage in October and

November 2008. Among the reasons that these increases occurred were facility expansions and the ramping up of gas being stored in new facilities.

Figure 1. Aggregate Volume Reported by Storage Fields that Attained their Highest Level of Working Gas in the Months, September 2006 through April 2009



Source: Energy Information Administration (EIA), Natural Gas Division. Volumes derived from data reported on the EIA-191M, "Monthly Underground Gas Storage Report."

Conclusion

The sum of demonstrated monthly peak working gas storage across all active storage fields over a 60-month period, 3,889 Bcf, is a useful, albeit somewhat conservative, measure of aggregate industry capability to store gas. By this measure, storage capacity is 2.6 percent above last year's level. Aggregate working gas design capacity, an upper bound estimate of gas storage capacity, was 4,313 Bcf as of April 2009, 4.3 percent greater than in April 2008.